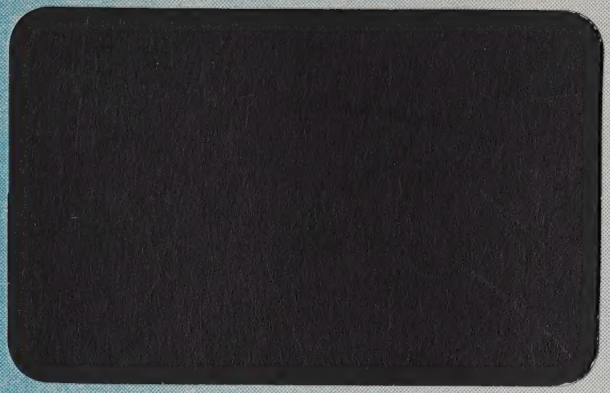
PRECISION



HOLT
INSTRUMENT
LABORATORIES
OCONTO WISCONSIN

MEASUREMENT

Bob Rouzie
contact man
at Holt Labs.

FILE COPY

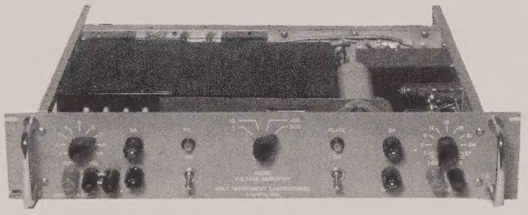
AVA-30

OPERATING AND SERVICE MANUAL

FOR

THE AUDIO VOLTAGE AMPLIFIER

MODEL AVA-30



HOLT INSTRUMENT LABORATORIES

OCONTO, WISCONSIN

TECHNICAL SPECIFICATIONS

INPUT:	1 Volt for Full Output
OUTPUT:	1 Volt at 0 to 10 Amp.
	10 Volt at 0 to 1 Amp.
	100 Volt at 0 to 100 Ma.
	300 Volt at 0 to 100 Ma.
FREQUENCY RESPONSE:	35 Cycles to 20 KC ± 1 db
HARMONIC DISTORTION:	0.1% + Input Distortion
INPUT IMPEDANCE:	100 K OHMS
LOAD COMPENSATION:	Manually adjusted at the front panel for any load power from 0 to 30 watts.
HUM AND NOISE:	90 db. below rated output
POWER SUPPLY:	115 volts ± 10%
	60 Cycles
	125 Watts
MECHANICAL:	RACK & PANEL MOUNTING
	3 1/2" High
	19" Wide
	13" Deep

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1-1 GENERAL DESCRIPTION

The model AVA-30 is an extremely high quality, 30 watt amplifier equipped with a special output transformer. Output voltages up to 300 volts may be obtained without the use of external step up transformers with their added distortion and impedance. It is provided with an internal load so that the operator may have a minimum of distortion regardless of the power required by the load under test. The output winding of this amplifier is isolated from ground, simplifying the solution of instrument ground loops.

Where precision voltage regulation at moderate power is required, the AVA-30 Audio Voltage Amplifier is an ideal companion to the AVS-320. Through the use of these two unique instruments it is possible to use pure sine wave, variable frequency AC voltages with a precision and stability usually obtainable only with DC. This combination may be used as a source for calibrating other AC instruments. and components with greater speed than bridge testing over a broad range of frequencies with no sacrifice of accuracy.

1-2 DAMAGE IN SHIPMENT

Examine the instrument carefully on arrival. If there is any apparent damage refer to "Damage in Shipment" at the front of this manual, for instructions.

1-3 POWER CABLE

A three conductor power cord is supplied with the instrument terminated in an NEMA recommended, polarized 3

prong male connector. The large rectangular pin should connect to the common side of the A.C. power line; the small rectangular pin to the hot side of the line. The chassis of the instrument is connected to the large round pin of the connector. It is important that this be connected to the ground connection which is returned to earth with a minimum of noise. Large amounts of noise or 60 cycle voltage on the instrument chassis will affect the operation.

1-4 POWER LINE VOLTAGE

The instrument is designed for operation on power line voltage of 115 volts plus or minus 10%. If line voltage is consistently high or low, the power transformers are provided with taps for 105 and 125 volts. In using these taps, care should be taken to prevent prolonged operation on high to low line voltages.

SECTION II
OPERATION

2-1 TERMINALS AND CONTROLS

Filament Switch: This toggle switch connects power to the primary of the filament transformer and one pole of the plate switch. When the filament switch is actuated the filament light will turn on.

PLATE SWITCH: This toggle switch connects power to the primary of the plate transformer provided the filament switch is on. A delay of at least 30 seconds should follow actuation of the filament switch to allow for ample tube warm-up. When the plate switch is actuated the plate light will turn on.

FUSES : The 1/2 ampere fuse on the left side of the panel is the filament transformer primary fuse. The 3 ampere fuse on the right side of the panel is in the plate transformer primary circuit.

LOAD CONTROL: The load watts switch controls the resistive load on the power amplifier.

INPUT LEVEL CONTROL: This control is a variable 100 K ohm potentiometer which selects the amount of input signal which will be applied to the grid of the preamplifier.

INPUT TERMINALS: The terminals on the left side of the instrument are connected to the input of the Power Amplifier through the input level control. The red terminal is the amplifier input, the black terminal is the signal ground.

OUTPUT TERMINALS: The terminals on the right side of the front panel are the common and signal output voltage.

terminals. The output common is completely isolated from any other common. Likewise, there is no internal connection between common and chassis ground. Grounding is achieved at the external terminals with the provided ground link to the black chassis ground terminal.

2-2 OPERATION:

With the power turned off, connect a high quality, low distortion oscillator to the input terminals. Turn on the oscillator and set its output for approximately 1.0 volt RMS at the desired frequency. Turn on the filament switch of the AVA-30. While allowing warm-up, select the desired output voltage with the voltage control switch and set the load watts switch for the approximate power to be consumed by the load under test. The load setting is not very critical, but should be within six watts of the required power for the lowest distortion.

Turn the input level control completely counter-clockwise and turn on the plate switch of the AVA-30.

Monitor the output with a reliable meter while increasing the input level. Do not over drive the amplifier or operate without proper load selection. To change input frequency or output voltage level, the AVA-30 input level control should be returned to the counter clockwise extremity and advanced slowly while monitoring the output. This insures that the selected output is never exceeded.

SECTION III
THEORY OF OPERATION

3-1 GENERAL

The AVA-30 consists of the following basic assemblies:

A. The Power Amplifier produces full output power continuously with less than 0.1% added distortion. The frequency response is plus or minus 1 db form 35 cps to 20,000 cps.

B. The Power Supply furnishes all the AC and DC power necessary to operate the instrument.

3-2 POWER AMPLIFIER

The power amplifier section is a high feedback linear amplifier designed to deliver 30 watts to a matched load with a very minimum of distortion. It consists of a triode preamplifier followed by a grounded grid phase inverter V-704. V-705 is a push pull amplifier stage with negative feedback on its plates from the output stage. This is followed by V-706, a push pull cathode follower driver stage. The output stage is made up of four 5881's V-707, V-708, V-709, & V-710 operating in push pull parallel. The output transformer primary is divided into matched plate and cathode windings so that the stage is D.C. self balancing. The output is operated in Class AB-1 with current flowing in each half during approximately 300 degrees of the cycle. The output of the transformer is fed back to the cathode of the first stage, V-703. The feed back in this loop is approximately 16 db.

The first stage plate is powered from a 105 volt supply regulated by the second half of V-703. This supply has

extremely low ripple and noise, the peak to peak-value being less than 2 mv. with zero signal on the amplifier.

3-3 POWER SUPPLY

The plate supply is a standard full wave rectifier coupled to a capacitive filter providing approximately 380 volts to the plates of the output tubes and the last two stages of the preamplifier. There is an additional 250 volt supply which is shunt regulated by V-701 and provides the plate potential of the phase inverter stage of the preamplifier. The initial preamp triode derives its plate voltage from a low ripple, 105 volt, regulated supply.

The negative supply is a standard half wave rectifier fed from the same plate transformer and supplying two negative levels. The first, a negative, capacitive, filtered 250 volt supply is used to bias the cathode follower and the output stages. The second, a 105 volt VR tube regulated negative voltage is employed as stable reference for the two electronic, plate supply voltage regulators.

SECTION IV
CALIBRATION

4-1 CALIBRATION PROCEDURE

The AVA-30 is designed and constructed with the utmost care and should have no trouble maintaining its rated specifications for the recommended calibration period or even longer. However, any instrument employing vacuum tubes undergoes a gradual change in characteristics causing a similar change in calibration. Therefore it is recommended that the AVA-30 be checked periodically under laboratory conditions. Casual adjustment in the plant or in the lab will almost certainly result in operation outside of specifications.

The following equipment is suggested for calibration of the AVA-30.

Audio Oscillator	HiLab Model AO.1
Distortion Analyzer	Hewlett Packard Model 330-B

Remove the unit from the cabinet or rack so that the necessary adjustment points are easily accessible.

Connect the Audio Oscillator to the AVA-30 input terminals as described in Operation Procedure, Section II.

Connect the output to the distortion analyzer and read the total harmonic distortion at frequencies of 35 cps, 1 kc, 10 kc, and 20 kc. The total distortion should not exceed 0.2%. If necessary, adjust the Distortion Balance Control (R-710) located at the top-rear of the unit, for minimum distortion.

SECTION V
MAINTENANCE

5-1 OVERHAUL AND FACTORY ADJUSTMENT PROCEDURE

Prior to shipment, the AVA-30 is subjected to a thorough inspection and calibration procedure in order to insure proper operation and attainment of specifications. Following is an outline of that procedure and the recommended test instruments:

Audio Oscillator	HiLab Model A0.1
Distortion Analyzer	Hewlett Packard Model 330B
Oscilloscope	Tektronix Model 531
Vacuum Tube Voltmeter	11 Megohm Input Resistance 3% Full Scale Accuracy

Variac, line voltage meter, ammeter, etc.

VISUAL INSPECTION

With power off, visually check for shorts, poor solder joints, loose or broken wires, missing or burnt components, etc.

OPERATIONAL CHECK ON THE POWER SUPPLY

With the plate switch in the off position, turn on the filament switch. Check the tube filaments for proper voltage as shown on figure 5-1. Allow at least 1 minute for warm up. Turn on the plate voltage, check the line current. At 115 volts, line current should not exceed 3 1/2 amperes. With a VTVM check the following test points for the proper voltages. Also check the peak to peak value of the ripple and the noise with the oscilloscope.

Test Point	DC Voltage	Ripple and Noise
C-727B	380 volts	3.0 volt peak to peak
Pin 1 V-701	250 volts	60 MV " " "
Pin 1 V-703	105 volts	2 MV " " "
C-728B	Neg. 250 volts	1 volt " " "
Pin 4 V-702	Neg. 105 volts	5 MV " " "

READ ALL TUBE VOLTAGES

With the recommended VTVM, read all the tube voltages indicated on Figure 5-1

ROUGH CHECK ALL THE OUTPUT VOLTAGE

Connect an AC meter capable of reading voltages up through 300 volts, to the output terminals of the instrument. Connect 1 volt at 1,000 cycles from an oscillator to the input terminals of the instrument. Gradually increase the setting of the input level control until an output of 1 volt is reached with the output selector switch in the 1 volt position. This should occur with input level setting between 3 & 4 on the level control. Leave the input level setting at this position, and check the output ranges 10,000 and 300 volt. The output voltages on each of these settings should be within 10% of the nominal value.

READ HUM LEVEL

With the output level switch in the 300 volt position, set the input level control fully counter clock wise. Short circuit the input terminals. Using the meter circuit of the Hewlett Packard 330-B, check the noise and hum at the output of the amplifier. It should be less than 1 millivolt. If it is not, check the noise and hum levels on the power supplies, particularly pin 1 V-703, also adjust the hum balance R-744. If this does not help, check the tubes for heater to cathode leakage.

AUDIO VOLTAGE AMPLIFIER
MODEL AVA-30

TUBE	TYPE	PIN 1	2	3	4	5	6	7	8	9
V701	6AB4	+250	-	-	Fil.	Fil.	-3	0	-	-
V702	0B2	-	-	-	-105	0	-	-105	-	-
V703	12AX7	+110	-0.6	0	Fil.	Fil.	+100	0	+1.4	Fil.
V704	12AU7	+215	0	+105	Fil.	Fil.	+215	0	+105	Fil.
V705	12AU7	+280	0	+18	Fil.	Fil.	+280	0	+18	Fil.
V706	12AX7	+380	-30	-29	Fil.	Fil.	+380	-30	-29	Fil.
V707	5881	-	Fil.	+380	+375	-29	-	Fil.	+4	-
V708	5881	-	Fil.	+380	+375	-29	-	Fil.	+4	-
V709	5881	-	Fil.	+380	+375	-29	-	Fil.	+4	-
V710	5881	-	Fil.	+380	+375	-29	-	Fil.	+4	-

Figure 5-1

READ AND MINIMIZE HARMONIC DISTORTION

With the instrument operating at 10 volts nominal output, connect the Hewlett Packard 330B. Read the direction at a number of frequencies between 35 cycles and 20,000 cycles. The total harmonic distortion should be less than 0.1% added to oscillator distortion. If necessary, adjust the distortion control on the Power Amplifier sub-assembly.

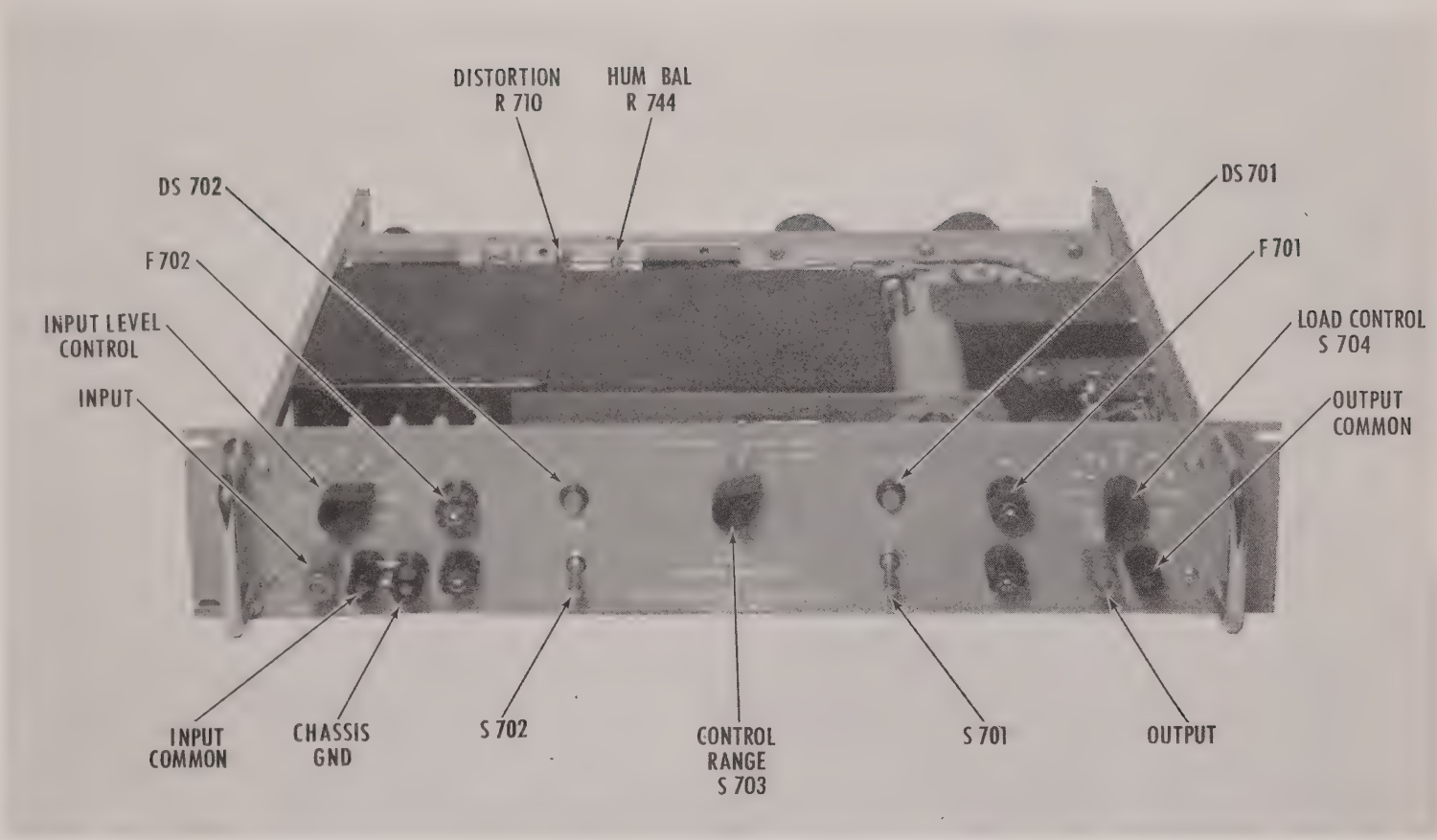
READ FEEDBACK LEVEL

With the input level control, turned fully counter clockwise and the plate voltage turned off, disconnect the feed back lead by removing one end of the feed back resistor R-733 and condenser C-708 from the terminal along side of the distortion control. Select the 10 volt output position and at 1000 cycles gradually increase the input level control until approximately 10 volts is reached. Caution: With no feed back the gain in the amplifier is considerably greater, as a result less than 1 volt input will produce the desired output. Do not exceed the selected output voltage. Reconnect the feed back loop, and read the new output voltage without changing the setting of the input level or oscillator. This new voltage should be between 17 & 19 DB below the rated 10 volts. If the feed back is less than this check the gain of the tubes in the amplifier. Repeat this check at a number of frequencies between 35 cycles and 20,000 cycles.

CHECK AMPLIFIER STABILITY

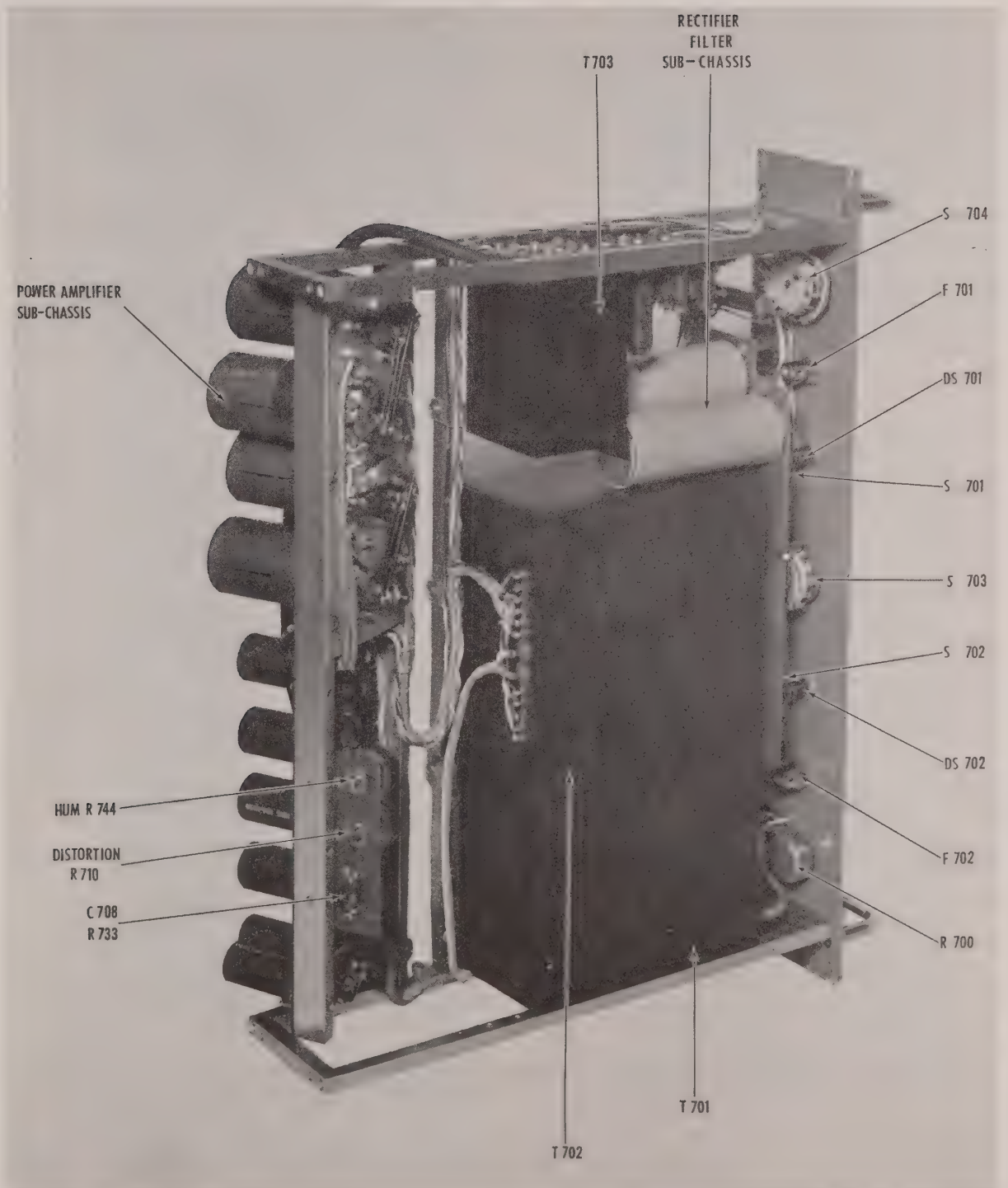
Connect the oscilloscope to the 250 volt regulated supply. Set the scope sensitivity for about 1 volt per centimeter. Rapidly and repeatedly switch the plate switch back and forth, observing the oscilloscope for any tendency toward sustained high frequency oscillations. Reconnect the oscilloscope to

the output terminals and repeat the above procedure. The presence of oscillations are an indication of amplifier instability sometimes due to excessive feedback, or an incorrect adjustment of C-708.



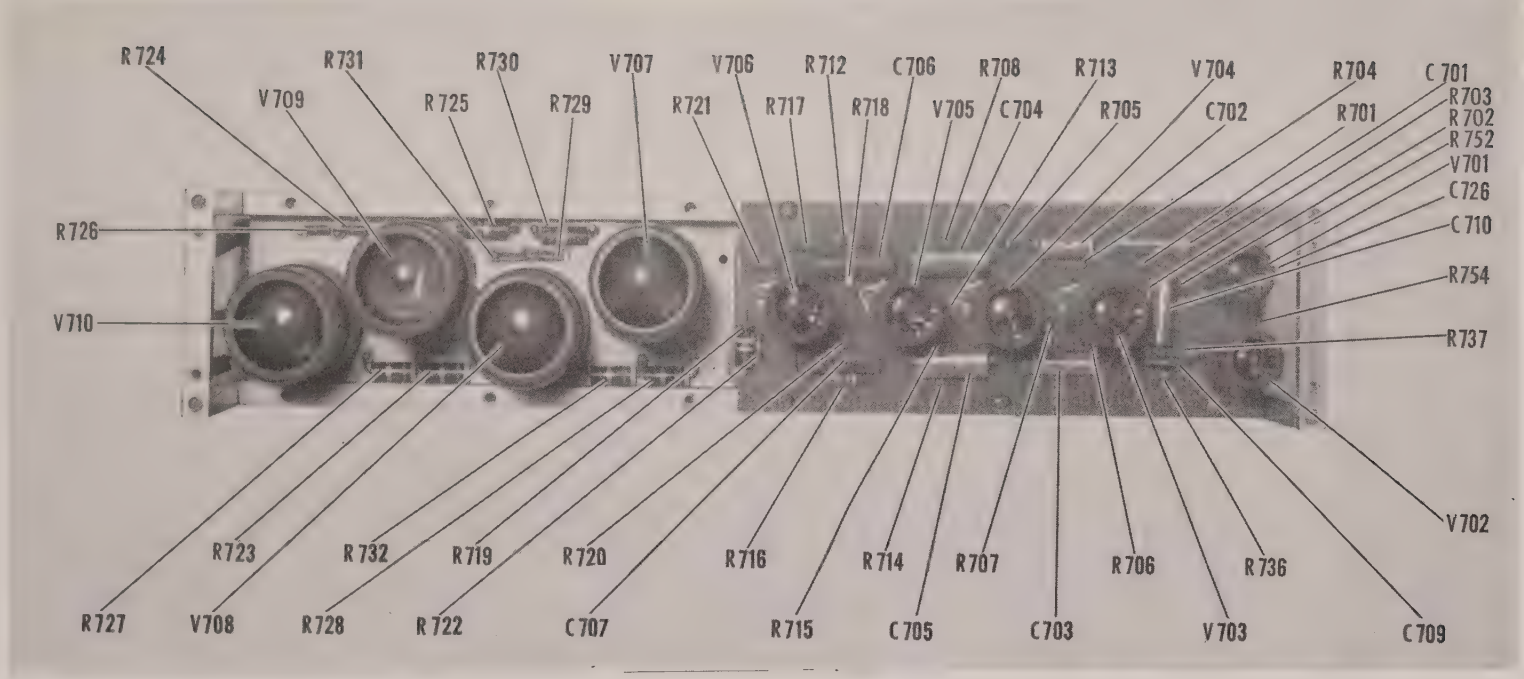
AVA-30

Front View

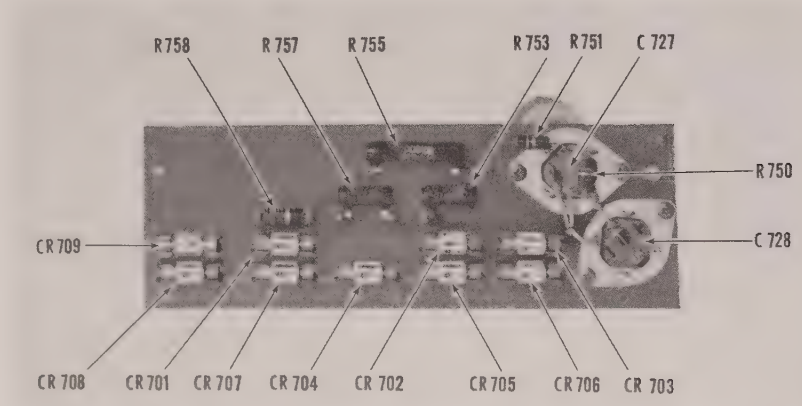


AVA-30

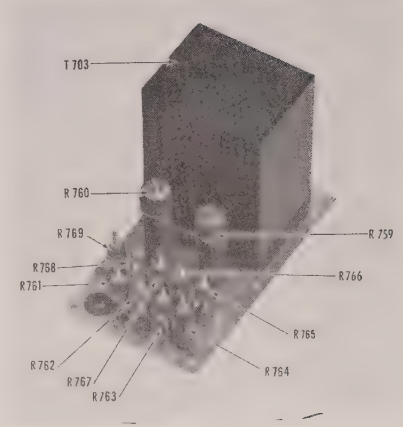
Rear View



AVA-30 Amplifier Assembly



Rectifier Filter



Filament Transformer
and Load Resistors

ELECTRONICS PARTS REFERENCE DESIGNATIONS

CP	Adapter, connector
A	Amplifier (other than rotating)
E	Antenna; aerial
A	Assembly
AT	Attenuator
DS	Audible signaling device
T	Autotransformer
BY	Battery
E	Bimetallic strip
TB	Block, connecting
B	Blower; fan; motor; prime mover
TB	Board, terminal
CB	Breaker, circuit
DS	Buzzer
W	Cable
C	Capacitor
E	Cell, Aluminum or electrolytic
V	Cell, light-sensitive, photo-emissive, or photo conductive
N	Chart
L	Choke
CB	Circuit breaker
M	Clock
HY	Coil, hybrid
L	Coil, induction, loading, relay operating, retardation, tuning
J	Connector, receptacle, electrical (with male, female, or male & female contacts and designed to be mounted on a bulkhead, wall, chassis or panel)
P	Connector, plug, electrical (with male, female, or male & female contacts, constructed to be affixed to the end of a cable, conduit, co-axial line, cord or wire)
K	Contactor (electrically operated
S	Contactor (mechanically or thermally operated)
M	Counter (indicating device)
CR	Crystal detector
CR	Crystal diode
Y	Crystal, piezoelectric
CR	Crystal unit
S	Cutout, thermal
CR	Detector, crystal
DS	Device, indicating (except meter or thermometer)
V	Electron tube
B	Fan
FL	Filter
DS	Flasher
F	Fuse
X	Fuseholder (see 5.6.1)
H	Hardware; bolts; nuts; screws
HR	Heater (element for Thermostat, oven, etc)
HY	Hybrid coil or junction
DS	Indicator
L	Inductor
MP	Interlock, mechanical
S	Interlock, safety, electrical
RT	Lamp, ballast
HR	Lamp, heating
DS	Lamp, illuminating
DS	Lamp, pilot
RT	Lamp, resistance
DS	Lamp, signal
X	Lampholder
LS	Loudspeaker
MP	Mechanical part
M	Meter
B	Motor
MP	Mounting (not in electrical circuit and not a socket)
N	Nameplate
Z	Network, general (where specific letters do not fit, when considered as a part)
AT	Pad
E	Part, miscellaneous electrical
R	Potentiometer
A	Power supply; source of power
J	Receptacle (connector, fixed)
CR	Rectifier, crystal or metallic
VR	Regulator, voltage (except an electron tube)
MP	Reed, vibrating
K	Relay (electrically operated contactor or switch)
R	Resistor
RT	Resistor, current regulating
R	Resistor, variable
R	Rheostat
CR	Selenium cell
E	Shield, electrical
R	Shunt
X	Socket (see 5.6.1)
L	Solenoid
LS	Speaker; loudspeaker
TB	Strip, terminal
S	Switch (mechanically or thermally operated
*TP	Test point
RT	Thermistor
TC	Thermocouple
M	Thermometer
S	Thermostat
M	Timer
MT	Transducer
T	Transformer
Q	Transistor
V	Tube, electron
Z	Tuned Circuit
CR	Varistor, asymmetrical
RV	Varistor, symmetrical
G	Vibrator, interrupting
DS	Visual signaling device
VR	Voltage regulator (except electron tube)

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. & Mfr. Designation
R 700	Resistor, Variable, Composition 100 K ohm, 2 Watt, ± 10%	OHM CU-1041
R 701	Resistor, Fixed, Composition 2.2 Meg. Ohm, 1/2 Watt ± 10%	OHM RC-20
R 702	Resistor, Fixed, Composition 100 K ohm, 1/2 Watt, ± 10%	same "
R 703	Resistor, Fixed, Composition 10 K ohm, 1/2 Watt, ± 10%	" "
R 704	Resistor, Fixed, Composition 10 K ohm, 1/2 Watt, ± 10%	" "
R 705	Resistor, Fixed, Composition 150 Ohm, 1/2 Watt, ± 10%	"
R 706	Resistor, Fixed, Composition 39 K Ohm, 1/2 Watt, ± 10%	"
R 707	Resistor, Fixed, Composition 2.2 Meg. Ohm, 1/2 Watt, ± 10%	"
R 708	Resistor, Fixed, Composition 27 K Ohm, 1/2 Watt, ± 10%	"
R 709	Resistor, Fixed, Composition 27 K Ohm, 1/2 Watt, ± 10%	"
R 710	Resistor, Variable, Composition 10 K Ohm, 2 Watt, ± 10%	OHM CLU 1031
R 712	Resistor, Fixed, Composition 47 K Ohm, 1 Watt, ± 10%	OHM RC-32
R 713	Resistor, Fixed, Composition 1 Meg Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 714	Resistor, Fixed, Composition 3.9 K Ohm, 1/2 Watt, ± 10%	same
R 715	Resistor, Fixed, Composition 1 Meg Ohm, 1/2 Watt, ± 10%	"
R 716	Resistor, Fixed, Composition 47 K Ohm, 1 Watt, ± 10%	OHM RC-32
R 717	Resistor, Fixed, Composition 18 K Ohm, 1/2 Watt, ± 10%	OHM RC-20

TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr. & Mfr. Designation
R 718	Resistor, Fixed, Composition 1 Meg Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 719	Resistor, Fixed, Composition 100 K Ohm, 2 Watt, ± 10%	OHM RC-42
R 720	Resistor, Fixed, Composition 1 Meg Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 721	Resistor, Fixed, Composition 220 K Ohm, 1/2 Watt, ± 10%	same
R 722	--same--	
R 724	Resistor, Fixed, Composition 100 Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 725	Resistor, Fixed, Composition 560 Ohm, 2 Watt, ± 10%	OHM RC-42
R 726	Resistor, Fixed, Composition 100 Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 729	Resistor, Fixed, Composition 100 Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 730	Resistor, Fixed, Composition 560 Ohm, 2 Watt, ± 10%	OHM RC-42
R 731	Resistor, Fixed, Composition 100 Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 733	Resistor, Fixed, Composition 1/2 Watt, ± 10% (Size depends on unit)	OHM RC-20
R 735	Resistor, Fixed, Composition 470 K Ohm, 1/2 Watt, ± 10%	same
R 736	Resistor, Fixed, Composition 1 Meg Ohm, 1/2 Watt, ± 10%	"
R 737	Resistor, Fixed, Composition 470 K Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 744	Resistor, Variable, Composition 50 Ohm, 2 Watt, ± 10%	OHM CLU-5001
R 750	Resistor, Fixed, Composition 82 K Ohm, 1 Watt, ± 10%	OHM RC-32
R 751	--same--	same

TABLE OF REPLACEABLE PARTS

~~Cir~~cuit Ref.	Description	Mfr. & Mfr. Designation
R 752	Resistor, Fixed, Composition 2.7 Meg Ohm, 1/2 Watt, ± 10%	OHM RC-20
R 753	Resistor, Fixed, Wire Wound 15 K Ohm, 5 Watt, ± 10%	OHM Brown Devil
R 754	Resistor, Fixed, Composition 1.2 Meg Ohm, 1/2 Watt, ± 10%	OHM RC-20
R-755	Resistor, Fixed, Wire Wound 30 K Ohm, 10Watt, 10 Watt, ± 10%	OHM Brown Devil
R 756	Resistor, Fixed, Wire Wound 100 Ohm, 20 Watt, ± 10%	same
R 757	Resistor, Fixed, Wire Wound 10 Ohm, 10 Watt, ± 10%	"
R 758	Resistor, Fixed, Composition 6.8 K Ohm, 2 Watt, ± 10%	OHM RC-42
R 759	Resistor, Fixed, Wire Wound 2250 Ohm, 25 Watt, ± 10%	OHM 03773
R 760	--same--	same
R 761	Resistor, Fixed, Wire Wound 350 Ohm, 5 Watt, ± 10%	OHM Brown Devil
R 762	Resistor, Fixed, Wire Wound 400 Ohm, 5 Watt, ± 10%	same
R 763	Resistor, Fixed, Wire Wound 500 Ohm, 5 Watt, ± 10%	"
R 764	Resistor, Fixed, Wire Wound 750 Ohm, 5 Watt, ± 10%	OHM Brown Devil
R 765	Resistor, Fixed, Wire Wound 1000 Ohm, 5 Watt, ± 10%	same
R 766	Resistor, Fixed, Wire Wound 1500 Ohm, 5 Watt, ± 10%	"
R 767	Resistor, Fixed Wire Wound 2500 Ohm, 5 Watts, ± 10%	"
R 768	Resistor, Fixed, Wire Wound 5000 Ohm, 5 Watt, ± 10%	"

TABLE OF REPLACEABLE PARTS

~~Cir~~cuit Ref.		Mfr. & Mfr. Designation
R 769	Resistor, Fixed, Wire Wound 15000 Ohm, 5 Watt, ± 10%	OHM Brown Devil
R 770	Resistor, Fixed, Wire Wound 100 Ohm, 10 Watt, Center Tapped	OHM 1668
R 771	Resistor, Fixed, Wire Wound 100 Ohm, 10Watt, Center Tapped	OHM 1668
C 701	Capacitor, Fixed, Metalized Paper .1 MFD, 200 VDCW	AEO P 123Z
C 703	Capacitor, Fixed, Metalized Paper .22 MFD, 400 VDCW	AEO P 123Z
C 704	Capacitor, Fixed, Metalized Paper .22 MFD, 400 VDCW	same
C 705	-same-	"
C 706	Capacitor, Fixed, Paper .02 MFD, 400 VDCW	MAL GEM-612
C 707	-same-	"
C 708	Capacitor, Fixed, Dur-Mica 500 VDCW, Adjusted for Minimum dist.	EM DM-15
C 709	Capacitor, Fixed, Disc. .01 MFD, 600 VDCW	C DD6-103
C 710	Capacitor, Fixed, Metalized Paper .1 MFD, 400 VDCW	AEO P 123Zg
C 711	Capacitor, Fixed, Electrolytic, Small 300 MFD, 3 VDCW	SP TE-1066
C 726	Capacitor, Fixed, Disc. .01 MF. 600 VDCW	C DD6-103
C 727	Capacitor, Fixed, Triple Section 80-40-20, 450 VDCW Electrolytic	MAL FP-378
C 728	Capacitor, Fixed, Double Section 40-40 MFD, 450 VDCW, Electrolytic	MAL FP-238
V 701	Tube, Electron	RCA 6AB4
V 702	-same-	RCA 0B2
V 703	"	RCA 12AX7

TABLE OF REPLACEABLE PARTS

Circuit Ref.		Mfr. & Mfr. Designation
V 704	Tube, Electron	RCA 12 AU7
V 706	" "	RCA 12 AU7
V 707	" "	RCA 12 AX7
V 708	" "	RCA 5881
V 709	" "	RCA 5881
V 710	" "	"
T 701	Transformer, Power	HIL P-3712
T 702	Transformer, Output	HIL TO-0201H
T 703	Transformer, Filament	HIL P-3713
CR 710	Rectifier, Silicon, 425 MA IN 1109, Max. P.I.V. 1200 V	ST 120 SM
CR 711	" " "	same
CR 712	" " "	"
F 701	Fuse, Slo-Blo 3 AG, 3 Amp	L.F. Type 313003
F 702	Fuse, Slo-Blo 3 AG, 1/2 Amp.	L.F. Type 313500
DS 701	Lamp, Neon, Miniature, Indication Clear Lens, W/100K Ohm. Res.	ELD Type IEG3
DS 702	-same-	same
S 701	Switch, Bat Handle, Toggle SPST, 3 A, 250 V.	AG&G 20994-LH
S 702	-same-	same
S 703	Output Voltage Selector Switch	HIL 700
S 704	Load Watts Switch	HIL 604